

# Class Copy Do Not Remove or Write On

## The Mendeleev Lab of 1869

In 1869 a Russian chemist called Dmitri Mendeleev published a periodic table. Mendeleev also arranged the elements known at the time in order of relative atomic mass, but he did some other things that made his table much more successful.

He realized that the physical and chemical properties of elements were related to their atomic mass in a 'periodic' way, and arranged them so that groups of elements with similar properties fell into vertical columns in his table.

Sometimes this method of arranging elements meant there were gaps in his horizontal rows or 'periods'. But instead of seeing this as a problem, Mendeleev thought it simply meant that the elements which belonged in the gaps had not yet been discovered. He was also able to work out the atomic mass of the missing elements, and so predict their properties. And when they were discovered, Mendeleev turned out to be right. For example, he predicted the properties of an undiscovered element that should fit below aluminum in his table. When this element, called gallium, was discovered in 1875 its properties were found to be close to Mendeleev's predictions. Two other predicted elements were later discovered, lending further credit to Mendeleev's table.

### Purpose:

Use your knowledge of the periodic table to determine the identity of each of the nine unknown elements in this activity.

The unknown elements are from the following groups in the periodic table. Each group listed below contains at least one unknown.

1      2      11      13      14      17      18

None of the known elements serve as one of the nine unknown elements.

No radioactive elements are used during this experiment. The relevant radioactive elements include Fr, Ra, At, and Rn.

You may not use your textbook or other reference materials. You have been provided with enough information to determine each of the unknown elements.

### Procedure:

1. Inspect the properties of the known elements.
2. Arrange the cards of the known elements in a crude representation of the periodic table.
3. Once the known elements are in place, inspect the properties of the unknowns to see where their properties would best "fit" the trends of the elements of each group.
4. In your data table, assign the proper element name to each of the unknowns. Record the symbol for each of the "unknowns" in your data table.

### Data Table:

Be sure to make your data table so that you have enough space for all your unknown elements.

### Conclusion:

Graph: Make two (2) graphs: Density and Melting Point. The x-axis should have element (moving from upper left hand corner to right hand corner across each row).

Summarize your group's reasoning for assignment of each unknown. Explain in a few sentences exactly how you predicted the identity of the unknowns.

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<b>Li</b>		<b>Cl<sub>2</sub></b>	
Physical State	solid	Physical State	gas
Density	0.534 g/cm <sup>3</sup>	Density	0.00321 g/cm <sup>3</sup>
Hardness	soft, claylike	Hardness	none
Conductivity	good	Conductivity	very poor
Solubility (H <sub>2</sub> O)	reacts with	Solubility (H <sub>2</sub> O)	slight
water		Melting Point	-101°C
Melting Point	180°C	Color	greenish yellow
Color	silver		

<b>Ag</b>		<b>He</b>	
Physical State	solid	Physical State	gas
Density	10.50 g/cm <sup>3</sup>	Density	0.00018 g/cm <sup>3</sup>
Hardness	somewhat soft	Hardness	none
Conductivity	excellent	Conductivity	very poor
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	961°C	Melting Point	-272°C
Color	silver	Color	colorless

<b>Cu</b>		<b>Na</b>	
Physical State	solid	Physical State	solid
Density	8.96 g/cm <sup>3</sup>	Density	0.971 g/cm <sup>3</sup>
Hardness	somewhat soft	Hardness	soft, claylike
Conductivity	excellent	Conductivity	good
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	reacts rapidly
Melting Point	1803°C	Melting Point	98°C
Color		Color	silver

<b>C</b>		<b>Ca</b>	
Physical State	solid	Physical State	solid
Density	2.10 g/cm <sup>3</sup>	Density	1.57 g/cm <sup>3</sup>
Hardness	soft, yet brittle	Hardness	medium
Conductivity	good	Conductivity	good
Solubility (H <sub>2</sub> O)	negligible	Solubility (H <sub>2</sub> O)	reacts
Melting Point	3550°C	Melting Point	845°C
Color	black	Color	silvery white

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Unknown #8		Unknown #9	
Physical State	solid	Physical State	solid
Density	1.74 g/cm <sup>3</sup>	Density	11.85 g/cm <sup>3</sup>
Hardness	medium	Hardness	very soft
Conductivity	good	Conductivity	medium
Solubility (H <sub>2</sub> O)	reacts slowly	Solubility (H <sub>2</sub> O)	none
Melting Point	651°C	Melting Point	303°C
Color	silvery white	Color	silvery white

Be		Sn	
Physical State	solid	Physical State	solid
Density	1.85 g/cm <sup>3</sup>	Density	7.31 g/cm <sup>3</sup>
Hardness	brittle	Hardness	somewhat soft
Conductivity	excellent	Conductivity	good
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	1287°C	Melting Point	232°C
Color	gray	Color	silver

Ne		Br <sub>2</sub>	
Physical State	gas	Physical State	gas
Density	0.00090 g/cm <sup>3</sup>	Density	3.12 g/cm <sup>3</sup>
Hardness	none	Hardness	none
Conductivity	very poor	Conductivity	very poor
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	negligible
Melting Point	-249°C	Melting Point	-7.2°C
Color	colorless	Color	reddish brown

K		Ba	
Physical State	solid	Physical State	solid
Density	0.86 g/cm <sup>3</sup>	Density	3.6 g/cm <sup>3</sup>
Hardness	soft, claylike	Hardness	soft
Conductivity	good	Conductivity	good
Solubility (H <sub>2</sub> O)	reacts rapidly	Solubility (H <sub>2</sub> O)	reacts strongly
Melting Point	63°C	Melting Point	710°C
Color	silver	Color	silvery white

## Class Copy Do Not Remove or Write On

<b>Xe</b>		<b>In</b>	
Physical State	gas	Physical State	solid
Density	0.00585 g/cm <sup>3</sup>	Density	7.31 g/cm <sup>3</sup>
Hardness	none	Hardness	very soft
Conductivity	very poor	Conductivity	medium
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-119.9°C	Melting Point	157°C
Color	colorless	Color	silvery white

<b>I<sub>2</sub></b>		<b>Pb</b>	
Physical State	solid	Physical State	solid
Density	4.93 g/cm <sup>3</sup>	Density	11.35 g/cm <sup>3</sup>
Hardness	soft	Hardness	somewhat soft
Conductivity	very poor	Conductivity	poor
Solubility (H <sub>2</sub> O)	negligible	Solubility (H <sub>2</sub> O)	none
Melting Point	113.5°C	Melting Point	327.5°C
Color	bluish-black	Color	gray

<b>Ar</b>		<b>Ga</b>	
Physical State	gas	Physical State	solid
Density	0.00178 g/cm <sup>3</sup>	Density	5.904 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	medium
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-189.2°C	Melting Point	30°C
Color	colorless	Color	silvery

<b>Cs</b>		<b>Unknown #1</b>	
Physical State	solid	Physical State	solid
Density	1.87 g/cm <sup>3</sup>	Density	2.33 g/cm <sup>3</sup>
Hardness	soft	Hardness	brittle
Conductivity	good	Conductivity	intermediate
Solubility (H <sub>2</sub> O)	reacts violently	Solubility (H <sub>2</sub> O)	none
Melting Point	29°C	Melting Point	1410°C
Color	silvery white	Color	gray

## Class Copy Do Not Remove or Write On

Unknown #2		Unknown #3	
Physical State	gas	Physical State	solid
Density	0.00170 g/cm <sup>3</sup>	Density	1.53 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	good
Solubility (H <sub>2</sub> O)	slight	Solubility (H <sub>2</sub> O)	reacts violently
Melting Point	-219.6°C	Melting Point	39°C
Color	pale yellow	Color	silvery white

Unknown #4		Unknown #5	
Physical State	gas	Physical State	solid
Density	0.00374 g/cm <sup>3</sup>	Density	19.3 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	excellent
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-156.6°C	Melting Point	1064°C
Color	colorless	Color	gold

Unknown #6		Unknown #7	
Physical State	solid	Physical State	solid
Density	2.54 g/cm <sup>3</sup>	Density	5.32 g/cm <sup>3</sup>
Hardness	somewhat soft	Hardness	fairly brittle
Conductivity	good	Conductivity	fair to poor
Solubility (H <sub>2</sub> O)	reacts rapidly	Solubility (H <sub>2</sub> O)	none
Melting Point	769°C		
Color	silvery white		
		Point	Melting 937°C
		Color	gray